CLINICAL AND LABORATORY STANDARDS INSTITUTE®

6th Edition

CLSI H21™

Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays

CLSI H21 provides procedures for collecting, transporting, and storing blood, processing blood specimens, storing plasma for coagulation testing, and general recommendations for performing the tests.

A guideline for global application developed through the Clinical and Laboratory Standards Institute consensus process.

Clinical and Laboratory Standards Institute

Setting the standard for quality in medical laboratory testing around the world.

The Clinical and Laboratory Standards Institute (CLSI) is a not-for-profit membership organization that brings together the varied perspectives and expertise of the worldwide laboratory community for the advancement of a common cause: to foster excellence in laboratory medicine by developing and implementing medical laboratory standards and guidelines that help laboratories fulfill their responsibilities with efficiency, effectiveness, and global applicability.

Consensus Process

Consensus—the substantial agreement by materially affected, competent, and interested parties—is core to the development of all CLSI documents. It does not always connote unanimous agreement but does mean that the participants in the development of a consensus document have considered and resolved all relevant objections and accept the resulting agreement.

Commenting on Documents

CLSI documents undergo periodic evaluation and modification to keep pace with advances in technologies, procedures, methods, and protocols affecting the laboratory or health care.

CLSI's consensus process depends on experts who volunteer to serve as contributing authors and/or as participants in the reviewing and commenting process. At the end of each comment period, the committee that developed the document is obligated to review all comments, respond in writing to all substantive comments, and revise the draft document as appropriate.

Comments on published CLSI documents are equally essential and may be submitted by anyone, at any time, on any document. All comments are managed according to the consensus process by a committee of experts.

Appeal Process

When it is believed that an objection has not been adequately considered and responded to, the process for appeal, documented in the CLSI *Standards Development Policies and Processes,* is followed.

All comments and responses submitted on draft and published documents are retained on file at CLSI and are available upon request.

Get Involved—Volunteer!

Do you use CLSI documents in your workplace? Do you see room for improvement? Would you like to get involved in the revision process? Or maybe you see a need to develop a new document for an emerging technology? CLSI wants to hear from you. We are always looking for volunteers. By donating your time and talents to improve the standards that affect your own work, you will play an active role in improving public health across the globe.

For additional information on committee participation or to submit comments, contact CLSI.

Clinical and Laboratory Standards Institute
P: +1.610.688.0100
F: +1.610.688.0700
www.clsi.org
standard@clsi.org

CLSI H21-Ed6
April 2024
Replaces CLSI H21-A5

Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays

Anne M. Winkler, MD
Laura A. Worfolk, PhD, MS, MLS(ASCP)
Donna Castellone, MS, MASCP, MLS(ASCP), SH
Marc D. Goldford, BS
Daniel Hesselgesser, MLS(ASCP)
Jeffrey S. Jhang, MD
Sharon Verg Johnson MBA, DLM(ASCP), CLT(State of NY), MLT
Kandice Kottke-Marchant, MD, PhD
Kevin J. McGlinchey, MLS(ASCP), CLs(CG)
Joern Meuer, PhD
Jeb Monasterial, MLS
Heddie L. Nichols, PhD, PHM
Malissa S. Norfolk, MLS(ASCP)^{CM}, SH^{CM}
Paul W. Riley, PhD, MBA
Renee Rosa, BS, MT, H(ASCP)
Sara P. Serna, DCLS, MLS(ASCP)^{CM}
Elona Turley, MD, FRCP(C)
Elizabeth M. Van Cott, MD
Nicholas Vanderslice, PhD
Oksana Volod, MD
Katherine Whelchel, MLS(ASCP)SH

Abstract

Clinical and Laboratory Standards Institute H21—*Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays* provides procedures for the collection, transport, and processing of blood specimens for plasma-based coagulation testing. Samples referred for coagulation testing are susceptible to preexamination errors, including those resulting from specimen collection and mixing, storage and transportation, various patient factors, and exogenous interferences. Thus, attention to these errors is important. CLSI H21 is primarily for laboratory and/or clinical personnel responsible for performing and interpreting plasma-based coagulation assays.

Clinical and Laboratory Standards Institute (CLSI). *Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays*. 6th ed. CLSI guideline H21 (ISBN 978-1-68440-228-1 [Print]; ISBN 978-1-68440-229-8 [Electronic]). Clinical and Laboratory Standards Institute, USA, 2024.

CLINICAL AND LABORATORY STANDARDS INSTITUTE®

Suggested Citation

CLSI. *Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays*. 6th ed. CLSI guideline H21. Clinical and Laboratory Standards Institute; 2024.

Previous Editions:
September 1980, January 1982, December 1986, December 1991, December 1998, December 2003, January 2008

CLSI H21-Ed6

ISBN 978-1-68440-228-1 (Print)

ISBN 978-1-68440-229-8 (Electronic)

ISSN 1558-6502 (Print)

ISSN 2162-2914 (Electronic)

Volume 44, Number 13

Committee Membership

Consensus Council

The Consensus Council sets priorities for CLSI standards development and votes on Final Draft documents to confirm that process requirements have been met. Consensus Council members are listed on the CLSI website: https://clsi.org/standards-development/consensus-council/

Document Development Committee on Preexamination Steps for Coagulation Testing

Anne M. Winkler, MD
Chairholder
Werfen
USA

Laura A. Worfolk, PhD, MS, MLS(ASCP)
Vice-Chairholder
Quest Diagnostics, Inc.
USA

Donna D. Castellone, MS, MASCP, MLS(ASCP), SH
Secretary
New York-Presbyterian Hospital
USA

Marc D. Goldford, BS
JM Bioscientific, LLC
USA

Daniel Hesselgesser, MLS(ASCP)
Centers for Medicare & Medicaid Services/CLIA Program
USA

Jeffrey S. Jhang, MD
The New York Blood Center
USA

Jeb Monasterial, MLS
FDA Center for Devices and Radiologic Health
USA

Katherine Whelchel, MLS(ASCP)SH
Diagnostica Stago
USA

Expert Panel on Hematology and Immunology and Ligand Assays

Expert panel volunteers support the development of CLSI documents by providing technical expertise in specialty areas. Expert panel members are listed by area of expertise on the CLSI website: https://clsi.org/standards-development/expert-panels/

Staff

Clinical and Laboratory Standards Institute
USA

David E. Sterry, MLS(ASCP)
Program Manager

Laura Martin
Editorial Manager

Catherine E.M. Jenkins, ELS
Editor

Kristy L. Leirer, MS
Editor

Lisa M.W. Walker, MS, ELS
Editor

Acknowledgment

CLSI, the Consensus Council, and the Document Development Committee on Preexamination Steps for Coagulation Testing gratefully acknowledge the following volunteers for their important contributions to the development of this guideline:

Donna D. Castellone, MS, MASCP, MLS(ASCP), SH
New York-Presbyterian Hospital
USA

Mary J. Doyle, PhD, MS, MLS(ASCP)
Instrumentation Laboratory
USA

Sharon Verg Johnson, MBA, DLM(ASCP), CLT(State of NY), MLT
Sysmex America, Inc.
USA

Kandice Kottke-Marchant, MD, PhD
Cleveland Clinic
USA

Kevin J. McGlinchey, MLS(ASCP), CLs(CG)
Greiner Bio-One, Inc.
USA

Joern Meuer, PhD
Siemens Healthcare Diagnostics Products GmbH
Germany

Karen A. Moffat, BEd, MSc, ART, FCSMLS(D)
Department of Medicine, McMaster University
Canada

Heddie L. Nichols, PhD, PHM
Genentech
USA

Malissa S. Norfolk, MLS(ASCP)^{CM}, SH^{CM}
University of Massachusetts Dartmouth
USA

Paul W. Riley, PhD, MBA
Diagnostica Stago
USA

Renee Rosa, BS, MT, H(ASCP)
Becton Dickinson
USA

Sarah P. Serna, DCLS, MLS, (ASCP)^{CM}
Centers for Medicare & Medicaid Services/CLIA Program
USA

Elona Turley, MD, FRCP(C)
Alberta Precision Laboratories and University of Alberta
Canada

Nicholas Vanderslice, PhD
Werfen
USA

Oksana Volod, MD
Cedars-Sinai Medical Center
USA

Acknowledgment in Memoriam of Our Expert Panel on Hematology and Immunology and Ligand Assay Contributor and Colleague

The Document Development Committee on Preexamination Steps for Coagulation Testing and the Expert Panel on Hematology and Immunology and Ligand Assay would like to acknowledge the endless and valuable contributions to this document by Dr. Elizabeth (Betsy) M. Van Cott (Massachusetts General Hospital). Dr. Van Cott was a true asset in the field of coagulation and laboratory medicine. Her passion for excellence and patient care was evident in all aspects of her work, and her contribution to this document will be a valuable tool for laboratories.

Contents

Contents (Continued)

Foreword

Highly sophisticated testing technology cannot produce good results from poorly collected specimens. CLSI H21 should enhance the uniformity of sample collection, preparation, and handling and thereby reduce many of the preexamination variables that can lead to inconsistent and erroneous coagulation test results.

Overview of Changes

This guideline replaces CLSI H21-A5, published in 2008. Several changes were made to this edition. One of the most prominent changes involved reorganizing the content into a process with multiple procedures, which is consistent with CLSI instilling QMS principles into its documents. CLSI H21 articulates a sequence of chronological procedures that comprise the process of successful collection, transport, and processing of human specimens for plasma-based coagulation testing. The quality system essentials (QSEs) are foundational building blocks that function effectively to support the laboratory's path of workflow. Although not all aspects of the QSEs may be mandatory, adherence to the QSEs ensures that the specimen collection, transport, and processing for plasma-based coagulation testing is performed at a higher level of overall quality.

Other changes include:

- Removing guidelines for molecular hemostasis assays
- Adding a discussion of preexamination patient factors that may affect coagulation tests (Subchapter 2.3)
- Adding a list of specimen collection issues of particular relevance to plasma-based coagulation testing (Subchapter 3.2)
- Adding a discussion of unconventional samples sent for coagulation testing (Subchapter 3.2.2)
- Removing the recommendation for 129 mmol/L, 3.8% dehydrate form of trisodium citrate
- Adding recommendations for the stability of whole blood samples when stored at room temperature (Chapter 4)
- Adding a discussion of sample preexamination issues (eg, hemolysis, icterus, lipemia) and interferences (eg, anticoagulants, coagulation factor concentrates) (Subchapter 5.4)
- Updating the recommendation for the stability of fresh and frozen plasma samples (Chapters 6 and 7)
- Updating the list of specimen rejection criteria (Chapter 8)
- Adding a discussion on troubleshooting preexamination issues (Subchapter 8.2)
- Updating references
- Adding Appendix A for commonly misordered coagulation tests

NOTE: The content of this guideline is supported by the CLSI consensus process and does not necessarily reflect the views of any single individual or organization.

KEY WORDS

activated partial thromboplastin time

anticoagulant

citrate

coagulation

interfering substance

preexamination variables

prothrombin time

sample storage

specimen collection

specimen transport

This page is intentionally left blank.

Chapter 1

Introduction

Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays

1 Introduction

1.1 Scope

CLSI H21 discusses procedures for the collection, transport, and processing of human specimens for plasma-based coagulation testing. The intended audience includes laboratory and clinical personnel responsible for performing and interpreting plasma-based coagulation testing and manufacturers of products involved in specimen collection, storage, and preparation, as well as testing of plasma-based coagulation assays.

CLSI H21 does not cover whole blood coagulation assays, platelet function tests, thrombin generation assays, point-of-care coagulation testing, or molecular coagulation assays. CLSI H21 also does not provide general guidelines for performing coagulation testing. Guidelines for performing specific coagulation assays are provided in other CLSI documents that cover prothrombin time (PT) and activated partial thromboplastin time (APTT) assays (CLSI H47,[1] CLSI H54[2]), factor activity assays (CLSI H48[3]), fibrinogen assays (CLSI H30[4]), D-dimer assays (CLSI H59[5]), lupus anticoagulant (LA) assays (CLSI H60[6]), and point-of-care coagulation testing (CLSI POCT14[7]).

1.2 Background

A procedural guideline for the collection, transport, and processing of specimens for plasma-based coagulation is necessary because many preexamination variables can affect test results (eg, concentration and volume of anticoagulant or additive and specimen and sample storage time and temperature). Additionally, important diagnostic and therapeutic decisions are based on the results of coagulation assays. Most laboratory errors occur in the preexamination phase, which includes specimen collection, collection container composition and anticoagulant, tube fill volume and mixing, sample transport and processing, and routine and frozen specimen storage. Samples sent for coagulation testing are especially susceptible to preexamination variables.

1.3 Standard Precautions

Because it is often impossible to know what isolates or specimens might be infectious, all patient and laboratory specimens are treated as infectious and handled according to "standard precautions." Standard precautions are guidelines that combine the major features of "universal precautions and body substance isolation" practices. Standard precautions cover the transmission of all known infectious agents and thus are more comprehensive than universal precautions, which are intended to apply only to transmission of bloodborne pathogens. Published guidelines are available that discuss the daily operations of diagnostic medicine in humans and animals while encouraging a culture of safety in the laboratory.[8] For specific precautions for preventing the laboratory transmission of all known infectious agents from laboratory instruments and materials and for recommendations for the management of exposure to all known infectious diseases, refer to CLSI M29.[9]